Amendment to Drawings

Amendment to Fig. 2 (see attached replacement sheet for amended Fig. 2):

1. A right pointing arrow connecting objects 1123 and 1126 is missing and has been added
2. Object 1324 is replaced so it is consistent with object 1324 in Fig. 5

Amendment to Fig. 4 (see attached replacement sheet for amended Fig. 4):

1. The label "DC VOLTAGE" of object 1151 is incorrect and it is replaced with the label "CW LASER"
2. The label "DATA SOURVE" of object 1161 is misspelled and it is replaced with "DATA SOURCE"

Amendment to Fig. 9 according to Examiner's recommendation (see attached replacement sheet for amended Fig. 9.):

1. The object "MONITOR BIT-ERROR-RATE" 1696 has been added and connected to object 1632 "TRANSMISSION FIBER" as described in amended paragraph [0115]
2. The object "MINIMIZE BIT-ERROR-RATE" 1697 has been added and connected to object 1696 "MONITOR BIT-ERROR-RATE" as described in amended paragraph [0115]
3. The object "MINIMIZE BIT-ERROR-RATE" 1697 is shown to connect to objects "CLOCK 1", "CLOCK 2", and "CLOCK N" 1693 to1695 and objects "DC VOLTAGE 1", "DC VOLTAGE 2", and "DC VOLTAGE N" 1690 to 1692 as described in amended paragraph [0115]

REMARKS

Claims 73, 74, 85, 87, 88, 105, and 106 were examined and amended. No new claims have been presented. No new matter has been presented.

Response to Item No. 1 of the Office Action:
Figures 2 and 4 have been amended. No new matter has been presented.
Figure 9 has been amended according to Examiner's recommendation. No new matter added.

Response to Item No. 3 of the Office Action:
Figure 9 has been amended to provide enablement of Claims 73-83 according to Examiner's recommendation. No new matter has been presented.

Figure 9 has been amended to provide enablement of Claims 85-94 according to Examiner's recommendation. No new matter has been presented.

Claim 105 has been amended to comply with enablement requirement according to Examiner's recommendation. No new matter has been presented.

Claim 106 has been amended to comply with enablement requirement according to Examiner's recommendation. No new matter has been presented.

Examiner wrote:

Claim 89 recites "modulating an amplitude is performed after combining the PSK optical data stream of the WDM channels" As shown in Fig. 9, the pulse modulator which provide amplitude modulating effect to the optical signal is provided before the WDM combiner. There is no structure of circuit diagram provided to show that the pulse modulator is provided after combining the PSK optical data stream. Therefore, the specification fails to provide enabling disclosure for claim 89.

Response:
Please refer to Fig. 10 which shows a circuit diagram illustrating the pulse modulator (1729) is provided after combining the PSK optical data stream.

Response to Item No. 5 of the Office Action:

Examiner wrote:

5. Claims 73-83 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 73 recites "pulse modulator... data modulator... and WDM combiner..." It is unclear how the various elements are connected together.

Response: Claim 73 has been amended to define clearly that these elements are connected together. Also, Fig. 9 shows how these various elements are connected together.

Examiner wrote:

Claim 73, recites " optical fiber having embedded therein optical signal comprising return-to-zero phase-shift-keyed optical signal" It is unclear which element provides RZ optical signal and which element generates the RZ-PSK optical signals.

Furthermore, it is unclear if the "optical fiber" is the same as the "PSK transmission line".

Response: Claim 73 has been amended to define pulse modulator provides RZ optical signal and PSK modulator connected to pulse modulator provides RZ-PSK signal. Claim 73 has been amended to define the PSK transmission line as the fiber transmission line.

Examiner wrote:

Claim 73 recites the limitation "the PSK transmission line" in line 10. There is insufficient antecedent basis for this limitation in the claim.

Response: Claim 73 has been amended to define the PSK transmission line as the fiber transmission line.

Examiner wrote:

Claim 73 recites the limitation "the data" in line 16. There is insufficient antecedent basis for this limitation in the claim.

Response: Claim 73 has been amended to define the data modulator as the PSK modulator.

Examiner wrote:

Claim 85 recites, "transmitting the RZ-PSKWDM optical signal along an optical fiber..." It is unclear which element provides RZ optical signal and which element generates the RZ-PSKWDM optical signals.

Response: Claim 85 has been amended to define the pulse modulator that provides the RZ optical signal and the plurality of PSK modulators that produce the RZ-PSKWDM optical signals.

Response to Item No. 7 of the Office Action

Regarding claims 73,74,79,85-90 and 105, Liu's application requires and specifies a PSK of RZ optical pulse in conjunction with polarization bit interleaving (Figure 1) before embedding into an optical fiber or a fiber optic network. Polarization bit interleaving requires the polarization states of a pair adjacent optical pulse to be orthogonal (paragraphs [0005], [0018], and [0027]). This particular polarization states arrangement applies to all optical channels before combining them into a single optical fiber as specified in Liu's application. The PSK pulse shape such as extinction ratio is not addressed nor specified in Liu's application. In the present invention, however, no particular polarization states of the PSK signals is imposed or required for any pair of neighboring optical pulses for any optical channels. Since the PSK pulse shape defined and specified in our application determines the spectral bandwidth, spectral overlap or crosstalk between closely spaced optical channels must be carefully considered. Consequently, the specifications for the wavelength combiner or wavelength division multiplexer in our application are different from Liu. Therefore, there are substantial difference in the channel combining approach between Liu's application and the present invention.

Liu, et al., fails to teach the concept of pulse shaping for mitigation of fiber nonlinearities regardless of the polarization state of the PSK RZ optical signal. Liu, et al., specified not only dispersion-managed link (see Figure 1) which typically uses not only non-zero dispersion fiber but also requires different types of fibers at the transmitter and receiver. As set forth in claim 79 of the present invention, pulse shaping is used to achieve optimal transmission performance in a non-zero dispersion fiber without the specific requirement of dispersion-managed link or any pre- or post-dispersion compensation.

Satoh's optical transmitter principle is fundamentally different from ours. In Satoh's optical transmitter, the amount of optical frequency fluctuation is controlled so as to optimize the transmission characteristics (see col. 14, lines 20-22). Our application, on the other hand, uses a pulse modulator to adjust the optical pulse temporal and spectral profile to achieve optimal transmission performance subject to multiple closely spaced optical channels propagating long distance of dispersive nonlinear optical transmission line. Satoh did not address the case of multiple optical information channels transmission. Satoh's optical transmitter suffered from chirp impairment leading to optical frequency fluctuation which must be properly compensated to combat fiber dispersion. Our pulse and PSK modulators, on the other hand, are based on push-pull Mach-Zehnder modulator which is inherently chirp-free therefore does not have optical frequency fluctuation impairment. Claims 87, 88, 105, and 106 have been amended to specify push-pull Mach-Zehnder modulator.

Regarding claims 74 and 86 define non-return-to-zero PSK optical pulses. These pulses defined in the specifications are fundamentally different from the conventional type of RZ optical pulses in Liu's application. In Liu's application, the RZ pulses have rising and falling edges go to zero (see Fig. 3). In our case, the non-return-to-zero PSK optical pulses do not necessary have edges go to zero as described in the specifications.

Response to Item No. 8 of the Office Action

Regarding claims 87, 88, 105, and 106, Liu's application did not disclose means of producing either BPSK or QPSK. Therefore, Liu's optical BPSK or QPSK signal is not expected to be the same as the BPSK or QPSK signal in the present invention. In the present invention, a push-pull Mach-Zehnder modulator (MZM) with switching voltage of V_π and biased at null with close to $2V_\pi$ drive swing voltage is preferred to produce the BPSK optical signal (paragraph [0094]). For QPSK optical signal, a pair of parallel push-pull MZMs with switching voltage of V_π and biased at null with close to $2V_\pi$ drive swing voltage is preferred to produce the QPSK optical signal. Liu's application does not specify the use of a MZM or push-pull MZM device to produce BPSK or QPSK signal. Claims 87, 88, 105, and 106 have been amended to reflect this.

Response to Item No. 9 of the Office Action

Regarding claims 75-78 and 80-82, these claims define the preferred range of parameters of the optical fiber (e.g., the zero-dispersion wavelength and the dispersion parameter) within the frame work of the present invention that maximizes the utilization and performance of the invention. The experimental and theoretical work conducted towards the verification this invention provides the preferred range of pulse shapes expressed in terms of extinction ratios that are optimally matched to the range of dispersion parameter of common optical fibers readily available. In contrast to Sarchi's patent, our claims of the fiber parameters do not involve or specify any internal structure, material parameters, or construction of the optical fiber itself. Therefore, claims 75-78 and 80-82 are valid and patentable.

Response to Items No. 10 of the Office Action

Regarding claim 83, the present invention describes the concept and technique on how to optimize transmission performance of WDM optical channels with PSK format in optical fibers. Taga's RZ pulse addresses the polarization effect only and the extinction ratio is based on single-channel (see Figures 1 and 4 of Taga's patent) OOK format only in which the RZ pulse is simply turned on and off to represent logic values of one and zero (see Figure 2C of Taga's patent). Taga's RZ pulse shape addresses neither fiber nonlinearities nor WDM crosstalk. The present invention examines WDM or multiple densely spaced optical channels of PSK RZ with pulse shaping. Thus, Taga's specification of the extinction ratio of RZ pulse is not applicable here and cannot be compared with the findings of the present invention.

Response to Items No. 11 of the Office Action

Regarding claims 91-94, in Satoh's patent the principle of the optical transmitter is fundamentally different from ours. In Satoh's optical transmitter, the amount of optical frequency fluctuation is controlled so as to optimize the transmission characteristics (see col. 14, lines 20-22). Our application, on the other hand, uses a pulse modulator to adjust the optical pulse temporal and spectral profile to achieve optimal transmission performance subject to multiple closely spaced optical channels propagating long distance of dispersive nonlinear optical transmission line. Satoh did not address the case of multiple optical information channels transmission. Satoh's optical transmitter suffered from chirp impairment leading to optical frequency fluctuation which must be properly compensated to combat fiber dispersion. Our pulse and PSK or data modulators, on the other hand, are based on push-pull Mach-Zehnder modulator which is inherently chirp-free therefore does not have optical frequency fluctuation impairment.

CONCLUSION

It is submitted that the present application is in form for allowance, and such action is respectfully requested.

The Commissioner is authorized to charge any additional fees, which may be required.

Respectfully submitted,
Celight, Inc.

Date: 4/21/2006 By: _____
Pak Shing Cho

Date: 4/21/2006 By: _____
Vladimir Grigoryan

Date: 4/21/2006 By: _____
Nadya Reingand

Date: 4/21/2006 By: _____
Isaac Shpantzer

Date: 4/21/2006 By: _____
Alper Demir

Date: 4/21/2006 By: _____
Aviv Salomon

12200 Tech Rd. Suite 300
Silver Spring MD 20904
Tel: 301-625-7000
Fax: 301-625-7001
ATTN: Nadya Reingand
Direct Line: 443-474-7797

CONCLUSION

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Nadya Reingand

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Isaac Shpantzer

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Alper Demir

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Aviv Salomon

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Date: 4/21/2006 By: Alper Demir

Date: 4/21/2006 By: Aviv Salamon

12200 Tech Rd. Suite 300
Silver Spring MD 20904
Tel: 301-625-7080
Fax: 301-625-7081
ATTN: Nadya Reingand
Direct Line: 443-474-7797